Mountaintop Mining/Valley Fill Environmental Impact Statement
Technical Study

WORK PLAN APPROACH FOR FILL STABILITY

August 9, 1999

I. Problem Statement

A typical mountain-top mining/valley fill (MTM/VF) operation in the Appalachian coalfields removes overburden and interburden material to facilitate the extraction of low-sulfur coal seams--requiring placement of excess spoil into adjacent valleys. These valley fills are some of the largest earth and rock fill embankments being built in the world today. Concerns have been expressed that mass movement or failure of a fill could endanger life, property, and the environment downstream.

This study plan will record instances of past fill failure as well as collecting indicator data regarding outward signs of fill instability. Geotechnical engineering assessments will be made on fill designs, construction practices, and as-built embankments.

II. Goals and Questions to be Addressed by This Work Plan

The steering committee for the Environmental Impact Statement (EIS) has adopted goals and questions to be addressed from several different perspectives: environmental, regulatory, and public service. This work plan, in conjunction with the other work plans and technical symposia that will be conducted during the preparation of the EIS, will attempt to address the following goals as adopted by the committee:

- Are fills adequately stable under the current regulatory scheme? If not, why and what alternatives are available?

III. EIS Team Members and Experts Consulted

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Experts Consulted: KYDSMRE: Mark Thompson; WVDEP: Lew Halstead; VADMLR: Bill Bledsoe; COE: Mike Gheen, Bob Yost, Mike Spoor; OSM: Mike Superfesky, Dave Lane, Mike Robinson

IV. Study Approach

The Surface Mining Control and Reclamation Act of 1977 established general engineering requirements for valley fills to assure mass stability of valley fills. OSM regulations provide even more specific requirements that, if properly followed during design and construction, establish a high probability against failure.

The EIS will evaluate State and Federal regulations, policies, and practices; geotechnical literature; and the conditions of existing valley fills to assess the effectiveness of current safeguards against future fill failures that may negatively affect public safety. The OSM study team (team) will conduct: (1) discussions with State/Federal inspection-and-enforcement and permit-review personnel and Federal geotechnical experts; (2) review of permits, inspection reports, and other relevant documentation; (3) aerial and ground-level site inspections; and (4) test drilling. The team will reach conclusions per the adequacy of the safeguards and will recommend improvements, where appropriate.

It is impractical for this evaluation (i.e., cost-prohibitive and an inadequate period of time) to definitively establish the geotechnical condition of thousands of fills throughout Appalachian mine sites. In fact, the various state regulatory programs routinely evaluate the company submission of this type of information in permits, evaluate the adherence to approved plans in monthly inspections, and assess the fills for signs of incipient or actual failure prior to making bond release decisions after construction. Company engineers and consultants perform extensive tests, stake their professional reputation and licenses on fill designs, document/certify critical construction phases, and certify quarterly. Therefore, this evaluation limits its focus to various indicators of regulatory program effectiveness in assuring long-term stability of fills

To perform a retrospective study definitively evaluating the mass stability of large earth and rock structures would require detailed knowledge of representative shear strength parameters of the fill and foundation material, as well as ground-water activity within the fill. With reliable excess spoil geotechnical strength parameters and internal pore water pressure information (along with the dimensions of the fill, foundation, and bedrock) a stability analysis could provide accurate engineering estimates for the factor of safety of the fill.

The following descriptions of the approach for each task assume the completion of the inventory of fill types, sizes, and location proposed under a separate study under the EIS; or, the existence of other inventories. Based on these inventories, the team will select candidate fills for the study.

Task 1: *Assemble all available literature on excess spoil disposal practice evaluations and compare the conclusions and recommendations with known current practices.*

- Assemble and review documents and literature pertaining to the construction of excess spoil fills. This includes National Academy of Science reports, contract research studies, oversight special studies, reports of investigation on specific fill problems, professional articles, regulation preambles, public hearing transcripts, court decisions, letters, memoranda, etc.

- Assess current Federal and State regulations as well as historic and current regulatory program policies and inspection practices.

- From the above reviews, develop an accounting of program-related problems and issues affecting fill construction and a historical perspective of the technical issues at hand.

- Compare issues and recommendations delineated in the reports to current day issues and practices for relevance. Use this information to guide data collection efforts for some of the other tasks outlined below.

Task 2: *Examine the feasibility of documenting that 80% durable rock (by unit volume) is attained during construction and in final fill configurations.*

The concept of 80% durable rock by unit volume is a valid one, theoretically--with respect to attaining long-term excess spoil fill stability. However, there is no known feasible representative sampling technique to evaluate a fill during or following construction to assess if the material placed meets the regulatory standard.

The team will consult with geotechnical experts throughout the Federal government for advice relating to:

- The "enforceability" of the current regulatory standard and the availability of alternative measurable standard(s).

- Possible use of a more rigorous durability classification system on overburden cores used in permit design.

- Greater controls on spoil selected for fill placement (e.g., selective handling controls to assure higher volumes of durable rock).

- Available techniques for in-pit sampling and testing of overburden to show that permit conditions are or are not field validated.

Task 3: *Evaluate the effectiveness of current sampling and testing protocols for establishing representative rock durability of excess spoil.*

OSM completed a comprehensive research study in 1990 that concluded the slake durability test is not particularly effective at discriminating rock durability. The study recommended a different testing protocol and rock durability classification system that more closely evaluates rock durability under the excess spoil disposal conditions of slaking in water and under compression in a fill. Under this task the team will continue to evaluate the rock-durability question through the following activities:

- Document the rock durability observations of SRA permitting and inspection staff through (1) phone or in-person interviews with I&E and permitting supervisors and (2) discussions with available State inspectors, permit reviewers, and technical staff in the course of performing tasks 5-13.

- Document the rock durability information supplied within the approved permit and comparing it to field observations under task 11.

- Recommend whether or not the rock-durability classification system proposed in the OSM study should be put forward for rule making.

Task 4: _Establish the effectiveness of current methods utilized in inspection and enforcement of excess spoil disposal._

- Determine if a fairly standard protocol for fill inspection is in effect in each state.

- Identify any issues or practices encountered about excess spoil disposal that concern the State staff.

Task 5: _Determine the population of documented fill failures since the permanent regulatory program, and the causative factor(s)._

- Assess any documented failures from reports gathered in Task 1 and failures known by the SRA to quantify the failure rate of permanent program fills.

- Compile a list of failure causes to see if any commonality exists. Use this information to guide survey and data collection efforts for other tasks.

Task 6: _Review strength parameters, phreatic surfaces, and failure analysis methods used in stability analyses in the approved permit._

- Based upon existing SRA fill inventory data or results from Evaluation Topic 1, compile a sample of permits with excess spoil fills of varying type (post-SMCRA durable-rock and post-SMCRA non-durable-rock), size (small, <3 MCY; medium, 4 to 20 MCY, large, >20 MCY), and stage of construction (fills still under construction and fills completed). Apply the sample to this and tasks 7-14.

- Review the permit applications of sample fills to identify and record values for shear strength, phreatic surface, and failure method used to assess fill stability.

- Compile the data into a database and compare them with accepted ranges for shear strength; expected phreatic surface; and, appropriate failure type.

Task 7: *Evaluate state surface mining information systems (SMIS), environmental resource information networks (ERIN) or other similar databases and compile violation data relative to excess spoil disposal.*

- Using the sample of permits selected for task 6, document the types of violations written on excess spoil disposal sites and develop a database.

- Evaluate the potential impact of the violations on fill stability.

Task 8: *Review documentation and certification of critical construction phases and quarterly certification.*

- Using the sample of permits selected for task 6, review photos and certifications of critical fill construction phases.

- Assess on-site conditions and fill construction methods pertinent to stability concerns and record observations for comparison in the field.

Task 9: *Establish if foundation conditions for fill placement are as defined in the approved permit*.

- Using same sample as in task 6, review permits to compare fill foundation preparation and underdrain placement documentation (color photos and RPE certifications submitted by the company as required by regulatory programs) with documentation of foundation test holes.

- Assess whether or not foundation conditions comport with fill design.

Task 10: *Aerial reconnaissance of a sampling of completed and fills under construction in WV, KY, and VA to visually assess stability, drainage control, and related features.*

- Using the samples selected for task 6, perform aerial surveys of the fills.

- Develop an inspection checklist to document the condition of each fill, including signs of instability (e.g. seepage, drainage control failure, ground cracks).

- Make video recordings of observations for further analysis at the office.

- Use the results of the aerial inspections to select sites for Task 11.

Task 11: *<u>On-the-ground visits to selected sites identified in 10, above to further assess stability, drainage control, and related features.</u>*

- Conduct on-the-ground inspections of fills selected from Task 10 to confirm conditions observed in the air and obtain more detailed information on the condition of slopes, seepage, drainage control systems, etc.

Task 12: *<u>Compare as-built fill configurations with as-designed.</u>*

Regulatory staff say it is a common occurrence that as-built fills are often very different configurations than proposed and approved in the original permit. Situations have been described when fills are much smaller than planned, or the fill site is not used at all. Whether a fill is constructed smaller or larger than planned can have definite impacts on the stability analyses and long term stability. Smaller fills tend to be higher in the watershed–sometimes where the natural ground is much steeper and instability could be more problematic due to less friction counteracting sliding/driving forces. Using the sample from task 6, the team will:

- Review the permits--and evaluate the fills during the aerial reconnaissance and on-the-ground inspections--to compare fill designs with as-built configurations.

- Estimate the potential effect of as-built variance from design on fill stability.

- Evaluate overburden characterization and coal exploration thoroughness in the permit to see if the reason(s) for variance can be determined.

- Document permit revisions, including stability analyses, for changes in design.

- Make recommendations for improving the rate of as built = as designed, if appropriate.

Task 13: *<u>Assess if proper surface and subsurface drainage controls are installed.</u>*

- Using the same sample of permits as task 6, inspect the fills during the aerial overflight and on-the-ground site visit for the presence of seepage contrary to the expected subdrain performance (as shown in the stability analysis assumptions).

- Document the designed surface drainage control system in the permit applications and compare with aerial/field observations of the as-built system.

- Note significant differences between the as-built and as-designed systems, if any, and document evident flaws.

Task 14: *Field verification of foundation conditions and phreatic surface projections in the permit.*

- Select several fill sites from the results of task 10 and 11 for subsurface investigation.

- Test drill each selected fill at two to three locations. For each test hole: (1) conduct on-site permeability tests on the fill material and underdrain system; and (2) complete well points or piezometers for ground-water monitoring.

- Explore the feasibility of sampling foundation soils for engineering-strength testing in the lab.

Final Report: The team will write a chapter to be incorporated into the EIS report. This chapter will provide an analysis of: technical and programmatic issues related to excess-spoil-fill stability; the results of the permit and inspection documentation review; and field inspections and testing. The chapter will also draw conclusions, where possible, on the long-term stability of the fills.

V. Cost Estimates

A. Contractual services for aerial reconnaissance

Source: USCOE

Amount: $45,000

B. Contractual services for drilling, testing and well development

Source: USCOE

Amount: $300,000

C. All other activities

Source: OSM budget accounts for salary and travel expenses